WE CLAIM:

1. An LED comprising REDGIVN (rare earth doped group IV nanocrystal) material.

2. The LED of claim 1 comprising in sequence:

a conductive substrate and/or bottom cladding;

the REDGIVN in a REDGIVN film;

a conductive and transparent layer on top of the REDGIVN film;

a first contact on top of the conductive and transparent layer and a second contact on the substrate;

wherein the LED is turned on by applying a voltage across the first contact and the second contact.

3. The LED of claim 2 wherein:

the substrate is selected from a group consisting of: comprises p or n silicon substrate or Transparent metal oxide semiconductors such as Zinc Oxide and III V compound semiconductor substrates, and diamond substrate;

the REDGIVN layer is a silicon rich silicon oxide (SRSO) film containing silicon nanocrystals doped with a rare-earth precursor,;

the conductive and transparent layer comprises a poly-silicon layer.

4. An LED according to claim 3 further comprising a small aperture is etched through the first contact to allow emitted light out.

5. An LED according to claim 3 wherein the first contact is a serpent contact to allow emitted light out.

6. An LED according to claim 1 comprising additional rare earth dopants in the REDGIVN layer so as to produce multiple colours.

7. An LED according to claim 6 comprising rare earth dopants for red, green and blue so as to produce white light.

8. An LED according to claim 1 comprising a plurality of layers of REDGIVN each separated by a buffer layer, and each containing a respective rare earth dopant.

9. An LED according to claim 8 wherein said plurality of layers of REDGIVN comprise three layers, one each for red, blue and green light.

10. An LED according to claim 9 wherein the rare earth ion are selected from a group consisting of: for blue light: Tetrakis(2,2,6,6 tetramethyl-3,5-heptanedionato)cerium(IV) and $Ce(TMHD)_4$; for a green light: Tris(2,2,6,6-tetramethyl-3,5-heptanedionato)erbium (III) $Er^{+3}(THMD)_3$; for a red light: Tris(2,2,6,6-tetramethyl-3,5-heptanedionato)europium (III) and $Eu(TMHD)_3$.

11. An LED according to claim 1 wherein the conductive substrate and/or bottom cladding are also transparent so as to allow some light to exit out the bottom of the device.

12. An array of LEDs each in accordance with claim 1.

13. An array of LEDs according to claim 12 wherein different rare earth dopants are used in respective subsets of the array.

14. An array of LEDs according to claim 12 arranged in groups of three, each group of three including a red light LED, a green light LED and a blue light LED so as to produce an overall white light LED.

15. An array of LEDs according to claim 12 wherein each LED is individually actuatable.

16. A group of three LEDs according to claim 1 wherein each of the three LEDs has a respective different rare earth dopant so as to produce one of red, green and blue light.

17. The group of LEDs according to claim 16 wherein each of the three LEDs is individually actuatable.

18. The group of LEDs according to claim 16 wherein the group of LEDs is collectively actuatable.

19. An optical laser comprising REDGIVN material.

20. An optical laser according to claim 19 comprising:

at least one waveguide comprising a REDGIVN channel;

at least one feedback element(s) defining a laser-laser-resonator cavity in the waveguide so that laser light is output from the waveguide when pumped;

a pump source.

21. An optical laser according to claim 20 wherein the pump source is a broadband optical pump source.

22. An optical laser according to claim 20 wherein the pump source is an electrical pump source.

23. An optical laser according to claim 20 comprising a substrate and/or bottom cladding below the waveguide and a top cladding.

24. An optical laser according to claim 20 wherein the laser cavity has a size, which is tuned to an excitation wavelength of the rare earth dopant.

25. An optical laser according to claim 20 wherein the at least one feedback element(s) comprise a first highly reflective mirror, and a second output coupler mirror which is partially reflective.

26. An optical laser according to claim 20 wherein the at least one feedback element(s) comprise a first Bragg grating which is highly reflective, and a second Bragg grating which is which is partially reflective.

27. An optical laser according to claim 20 wherein the feedback elements are frequency selective, and are tuned to be most reflective near a resonant frequency of the cavity.

28. An optical laser according to claim 20 further comprising means for varying the wavelength(s) reflected by the feedback element(s) and varying the effective length of the resonator cavity to thereby tune the laser to a selected wavelength.

29. An array of lasers according to claim 20 formed on a common substrate.

30. The array of lasers according to claim 29 wherein each laser of the array of lasers has resonant characteristics and dopants selected to produce a respective different wavelength.

31. The array of lasers according to claim 30 wherein each laser has a respective laser cavity having a different length.

32. A laser according to claim 20 further comprising a Diffraction Bragg reflector (DBR) grating formed into or close to the waveguide is used to tune the wavelength of light supported in the waveguide cavity.

33. A laser according to claim 20 wherein the resonance characteristics of the waveguide cavities are individually selected by varying the pitch of the reflection gratings used to define the cavities which, along with the effective refractive index for the propagated optical mode, determines the wavelengths of light reflected by the gratings.

34. A laser according to claim 20 comprising a surface-relief grating forming a distributed Bragg reflection grating fabricated on a surface of the wave guide.

35. A laser according to claim 20 comprising:

a conductive substrate having a first electrical contact;

a transparent conductive cladding buffer;

a layer comprising the wave guide,

a second electrical contact on top of the REDGIVN channel;

an electrical pump source.

36. An optical laser according to claim 35 wherein the at least one feedback element(s) comprise a high reflecting mirror and output coupler at opposite each end of the waveguide to form the resonating cavity.

37. A laser component comprising:

a thin film containing REDGIVN and having a plurality of waveguides defined by channels within the substrate;

one or more feedback elements for providing optical feedback to the waveguides to form a respective laser-resonator cavity in each wave guide with a distinct resonance characteristic to provide lasing action at a selected

wavelength when pumped, wherein injection of pump light at one or more suitable wavelengths into the laser-resonator cavity causes output of laser light at the selected wavelength in accordance with a longitudinal cavity mode of the cavity.

38. A laser according to claim 37 further comprising:

a ferrule having a plurality of spaced-apart attachment sites; and

a plurality of optic fibers attached to the ferrule at a respective one of the plurality of spaced-apart attachment sites, each optical fiber also being connected to receive light from a respective one of the resonator cavities.

39. A laser according to claim 37 wherein the laser-resonator cavities have a plurality of widths on a substrate surface to thereby define a plurality of effective indices of refraction for the cavities, the wavelength of a longitudinal cavity mode being dependent thereon.